METHOD FOR TRANSMITTING TIME-CRITICAL DATA PACKETS IN DIGITAL WIRELESS TRANSMISSION SYSTEMS

DESCRIPTION

The invention concerns a method for transmission of time-critical data packets.

A transition from analog to digital transmission systems is now occurring in television technology. A source code method, operating according to the MPEG standard, is known in conjunction with digital transmission systems. This permits data compression, which allows particularly efficient data transmission. For example, it was possible in analog technology to transmit a television program on a satellite transponder with 33 MHz bandwidth. On the other hand, five to ten programs of the same quality can be transmitted on the same transponder with digital technology.

In the MPEG standard, the individual programs are transmitted in time multiplex in the form of data streams, which are divided into blocks or data packets. A program consists of several data streams of different type (video information, audio information, auxiliary information), the so-called elementary data streams. The elementary data streams of a program are combined in a program multiplexer to a program data stream. Several program data streams are assembled in a transport multiplexer to a transport data stream. This is transmitted to a satellite via a so-called uplink, which converts the signal and distributes it for satellite direct reception at the viewer.

The MPEG data stream is regenerated from the signals received by a satellite antenna by means of a satellite receiver or a set top box and fed to a television or video recorder connected downline. Separation of data packets pertaining to a desired television program and MPEG decoding occur there. The data packets pertaining to the desired television program are transmitted in time multiplex with data packets allocated to other programs and are therefore

spaced from each other in time. In each of the data packets that are assigned to the desired program, data are contained that give information about the time of transmission of the next data packet that pertains to the desired program. This information concerning the time of transmission of the next data packet is used by the MPEG decoder to set a time window, in which the appearance of this next data packet that must be subjected to MPEG decoding is waited for. Consequently, data packets that do not belong to the desired program need not be checked and temporarily stored in the MPEG decoder. The storage capacity of the memory in the MPEG decoder must consequently be only large enough so that a complete data packet can be decoded. During transmission of MPEG-coded data packets, time-critical data packets are therefore involved, whose relative time position with respect to each other must be known during MPEG decoding.

This information concerning the time position of individual data packets of a desired radio program relative to each other, however, is lost if MPEG-coded signals are to be transmitted, for example, via a radio transmission link whose transmission bandwidth is much smaller than the bandwidth available for satellite transmission of MPEG-coded signals. Both the latency and travel time of data packets are not predictable in wireless radio transmission systems, since they are dependent on the system occupation (CSMA access) and on the transmission distance.

Starting from this prior art, the underlying task of the invention is to provide a new way, with which time-critical data packets can be transmitted over a travel time-burdened transmission link.

This task is solved by a method with the features stated in Claim 1. Advantageous embodiments and modifications of the invention are objects of the dependent Claims 2 to 8. Consumer electronics devices are mentioned in Claims 9 to 15, which can be used in conjunction with execution of the method according to the invention.

The advantages of the invention consist especially in the fact that, by impressing time information on the transmitter side on each of the data packets being transmitted, information

is available on the receiver side that permits the individual data packets to be made available with exactly the same relative time position with respect to each other as they had on the transmitter side. Because of this, undesired travel time effects that occur on the transmission link are fully compensated, so that the data packets can be decoded in an MPEG decoder arranged on the receiver side that requires the data packets in the correct time position.

By means of the features stated in Claim 2, a situation is achieved in which the time-critical data packets can also be transmitted over a transmission line with limited bandwidth.

According to Claim 4, the data packets spaced from each other in time are separated from an MPEG data stream. The time intervals present between the separated data packets favor scanning rate conversion.

According to Claim 7, the time-critical data packets are transmitted from a first to a second consumer electronics device. For example, in this manner, MPEG-coded signals in a private household can be transmitted from a television, to which the MPEG transport stream is fed, in wireless fashion to another consumer electronics device arranged in the same room, for example, a video recorder or radio receiver, and MPEG-decoded only there. Transmission of MPEG-coded signals from a first to a second consumer electronics device is advantageous, among other things, because MPEG-coded signals are provided with high error protection, so that high transmission security is guaranteed on the transmission link.

Consumer electronics devices are mentioned in Claims 9 to 11 that can be used on the transmitter side in the claimed method. Claims 12 to 15 describe consumer electronics devices that can be used on the receiver side.

A practical example of the invention is described below by means of figures.

In the figures:

FIG 1 shows a block diagram of a device for execution of the claimed method.

FIG 2 shows a time diagram to explain the individual steps of a first variant of the claimed method and

FIG 3 shows a time diagram to explain the individual steps of a second variant of the claimed method.

Figure 1 shows a block diagram of the device for execution of the claimed method. The depicted device has a satellite receiver or a set top box 1, by means of which an MPEG transport stream, as emitted by a radio satellite, is regenerated and made available to a demultiplexer 2. Such an MPEG transport stream is shown in Figure 2a and has a number of data packets that are denoted with letters A, B, C and D. The data packets designated A pertain to a television program A, the data packets designated B pertain to a television program B, the data packets designated C pertain to a television program C, and the data packets designated D pertain to a television program D. The data packets pertaining to television program B are selected from the MPEG transport stream in demultiplexer 2, which is shown in Figure 2b.

For later MPEG decoding of these data packets, information concerning the relative time position of the individual data packets shown in Figure 2b is necessary. To obtain such information, a system clock 4 is provided, in which a high-precision counter can be involved. This generates a high frequency timing signal, as shown in Figure 2c. The counting value present at the beginning of each data packet B is determined in device 3 as time information for the corresponding data packet and tagged to this data packet. Figure 2d shows the mentioned data packets, to which time information 13 has been tagged.

The data packets with the tagged time information 13 are fed to a data rate converter 5 and reduced or time-expanded in data rate. Transmission of the data packets with the tagged time information is made possible by this time expansion via a radio transmission channel, whose bandwidth is much smaller than the bandwidth available for satellite transmission of the MPEG transport stream. The data packets reduced in data rate are shown in Figure 2e.

The output signal of the data rate converter 5 is fed to a radio transmitter 6 and converted in it to a radio signal suitable for radio transmission. This radio signal is transmitted via a radio transmission link 7, which is shown in Figure 2 with a dashed line.

The signal experiences a time delay in unknown fashion on the radio transmission link, so that the time-delayed radio signal shown in Figure 2f arrives on the receiving side. There it enters a radio receiver 8, in which the radio signal is processed in a manner inverse to radio transmitter 6. The output signal of the radio receiver 8 is fed to a data rate converter 9 and time-compressed again there, in order to restore the original data rate of the signal. The output signal of the data rate converter is shown in Figure 2g.

The signal raised again in data rate reaches a device 10, which is provided to separate the data packets from the transmitted signal and has an intermediate memory for the separated data packets.

A system clock 11 is also provided on the receiver side, in which a high-precision counter can again be involved. This is synchronized by the transmitted signals and provides device 10 with high-frequency timing signals, which are shown in Figure 2h. Memory control signals to control the readout process from the memory are generated in device 10, using the timing signals delivered by the system clock 11 and the transmitted time information, so that the individual data packets are prepared with the same time spacings relative to each other as they had on the transmitter side. This is shown in Figure 2i.

The data packets shown in Figure 2i, in comparison with the data packets shown in Figure 2b, do have a time lag, which is caused by the different signal processing steps shown in Figure 1, but occur relative to each other at exactly the same time spacings as the data packets shown in Figure 2b.

The data packets shown in Figure 2i are fed to the MPEG decoder 12 and subjected there to MPEG decoding. The output signal of the MPEG decoder 12 is finally further processed in known fashion, for example, converted to a signal that can be displayed on the screen of a television or recorded by means of a video recorder.

The invention just described can be applied, for example, to transmit data packets separated from an MPEG transport stream, which pertain to a desired radio program, from a first consumer electronics device in wireless fashion to a second consumer electronics device. The first consumer electronics device can, like the second consumer electronics device, be a television, video recorder or a radio receiver. In the mentioned first device, the demultiplexer 2, the system clock 4, the device 3 to determine the relative time position of the individual data packets with respect to each other and to add time information to each of the data packets, the data rate converter 5 and the transmitter 6 are provided. The mentioned second device has the receiver 8, the data rate converter 9, device 10 to separate the data packets and for intermediate storage of the separated data packets, system clock 11, the device provided with time information to control the readout process and the MPEG decoder 12.

Figure 3 shows another practical example for transmission of data packets A, B, C, D of an MPEG transport stream, in which the time information for the individual data packets is transmitted as separate common time information blocks 26, 27, 28, 29, 30, 31 for individual data blocks 20, 21, 22, 23, 24, 25. Otherwise, the procedure for generation and recovery of the time information corresponds essentially to the procedure already described in conjunction with Figures 1 and 2. Thus, the data packets pertaining to television program B are selected from the MPEG transport stream in demultiplexer 2 (cf. Figure 1), which is shown in Figure 3b. For later MPEG decoding of these data packets, information concerning the relative time

position of the individual data packets shown in Figure 3b is required. To obtain such information, a system clock 4 (Figure 1) is again provided, which generates a high-frequency timing signal, as shown in Figure 3c. The counting value present at the beginning of each data packet B is determined in device 3 as time information for the corresponding data packet and arranged as time information 26 in data packets 26, ... 31. Figure 3e shows the mentioned data packets 20, ... 25, each of which is followed by a time information data blocks 26, ... 31. This time information data blocks 26, ... 31 contain the time information for data packets 20, ... 25. As already explained in conjunction with Figures 1 and 2, the data packets 20, ... 25 with the following time information blocks 26, ... 31 are reduced or time-expanded in data rate. By this time expansion, transmission of the data packets with time information is made possible over a radio transmission channel, whose bandwidth is much smaller than the bandwidth available for satellite transmission of the MPEG transport stream. The data packets reduced in data rate are shown in Figure 3e. Transmission via a radio transmission channel is again shown with a dashed line in Figure 2.

The signal undergoes a time delay in unknown fashion on the radio transmission link, so that the time-delayed radio signal shown in Figure 3f arrives on the receiver side. On the receiver side, it is fed to a data rate converter 9 and time-compressed there again, in order to restore the original data rate of the signal. The output signal of the data rate converter is shown in Figure 3g. A system clock 11 is again provided on the receiver side. This is synchronized by the transmitted signals and provides device 10 with a high-frequency timing signal, which is shown in Figure 3h. Memory control signals to control the readout process from the memory are generated in device 10, using the timing signals delivered by system clock 11 and the transmitted time information 26, ... 31, so that the individual data packets are produced with the same time spacing relative to each other as they had on the transmitter side. This is shown in Figure 3i. The data packets shown in Figure 3i, in comparison with the data packets shown in Figure 3b, do have a time delay, which is caused by the different signal processing steps shown in Figure 1, but occur relative to each other in exactly the same time spacings as the data packets shown in Figure 3b.

The invention just described is applicable, for example, in order to transmit data packets separated from an MPEG transport stream that pertain to a desired radio program from a first consumer electronics device in wireless fashion to a second consumer electronics device. The first consumer electronics device, like the second consumer electronics device, can be a television, a video recorder or a radio receiver. In the mentioned first device, the demultiplexer 2, the system clock 4, the device 3 for determination of the relative time position of the individual data packets with respect to each other and to add time information to each of the data packets, the data rate converter 5 and the transmitter 6 are provided. The mentioned second device has the receiver 8, the data rate converter 9, the device 10 for separation of the data packets and for intermediate storage of the separated data packets, the system clock 11, the device provided with time information to control the readout process and the MPEG decoder 12.

After all this, a common time basis is created for the mentioned transmission by means of the invention, based on which the relative time ratios of the individual data packets present on the transmitter side can be reproduced in the receiver. This is an essential prerequisite for being able to use an ordinary MPEG decoder on the receiver side, which, because of its limited storage capabilities, imposes critical time requirements on the data packets fed to it.